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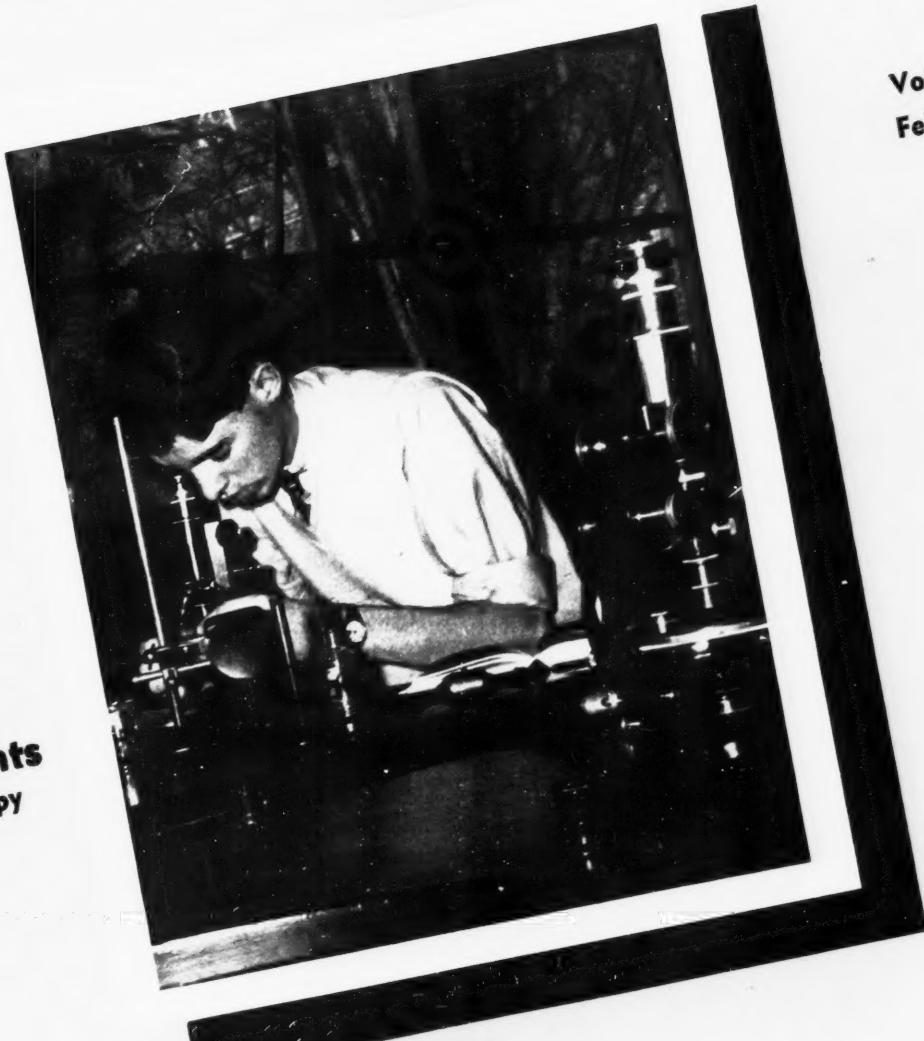

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The CORNELL ENGINEER

Volume 12 Number 5

CONTENTS

Cover: A Chemical Engineer studies crystal structure in Professor C. W. Mason's microscopy lab in Olin Hall.

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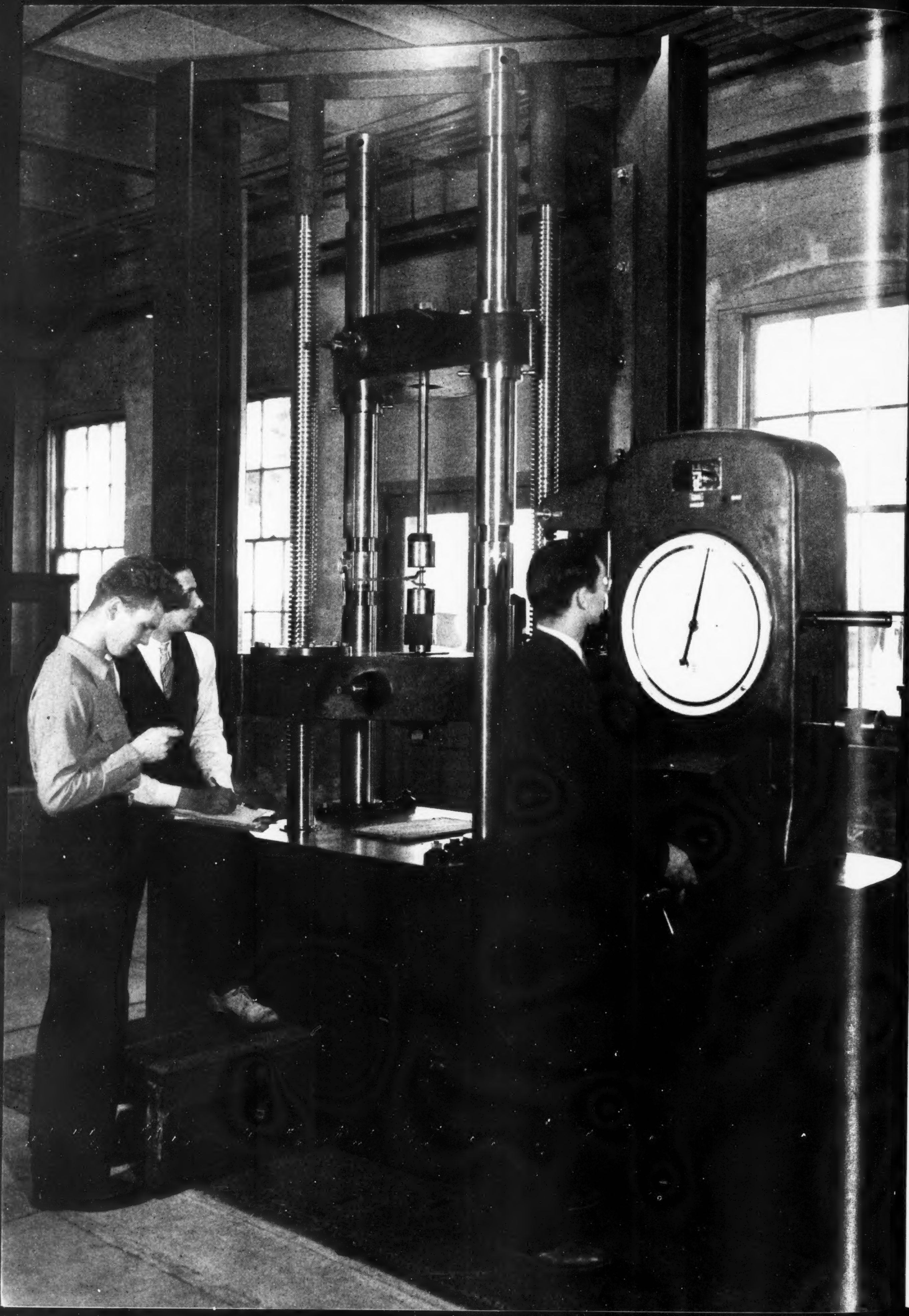

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Metallurgical Engineering

Engineering at Cornell (20)

By PETER E. KYLE, M.E. '33
Professor of Metallurgy

Metallurgical Engineering in its broadest meaning involves the application of physical and chemical metallurgical principles to the extraction, refining, alloying, melting, casting, hot and cold forming, welding, heat-treating, and finishing of metals for industrial uses. Education in this field had its beginning many years ago when the major problems centered around the mining, extraction and refining operations. At that time the main purpose was to train the supervisory staff in the mineral industries, and it was not until around 1880 that any attention was paid to the application of the principles of science to provide methods of making quantitative metallurgical calculations. Following this noted period of development by about ten years came the realization that, with the aid of the microscope, studies of polished metal surfaces would reveal their structure and provide the information needed to guide manufacturing processes toward improvement in the quality of the product.

Shortly after the turn of the century, it became very evident that the trend in the teaching and practice of metallurgy was toward two separate divisions, one called "process metallurgy," and the other "physical metallurgy." Process metallurgy has now come to embrace extraction and refining operations; physical metallurgy covers the manipulation of liquid and solid metal and the control and determination of its physical, chemical and mechanical properties and general usability. At that time the term "physical metallurgy" was not too appropriate since the laws of physics were seldom applied, but in recent years, concepts of modern physics have been very widely used in the study of metals.

Engineering Materials

During these important periods in the development of metallurgy and since those times, the faculty in the College of Engineering at Cornell has contributed greatly in advancing the field of physical metallurgy as it relates to the use of metals in machines and structures.

Professor Robert H. Thurston, Director of the Sibley College of Mechanical Engineering from 1885 to 1903 published three volumes on the Materials of Engineering in 1882 and revised these several times while at Cornell. Two of these volumes were on metallic materials. The series was written to acquaint the mechanical and electrical engineering students with the occurrence, extraction, refining, casting, working, and testing of materials. What was thought necessary at that time can be noted from the following quotation from Vol. III on "Brasses, Bronzes, and Other Alloys":

"The requirements of the engineer include some acquaintance with the general principles, and with the experimental knowledge, which are to be obtained by the study of geology, of mining, and of metallurgy, to aid him in selecting the metals used in his constructions; since their qualities cannot always be determined by simple inspection, and it is not always possible to subject them to such tests as he may consider desirable before purchasing. In such cases, a

Teamwork in tension. Students testing a half-inch specimen on the 200,000 lb. Olsen universal machine.

THE AUTHOR

Peter Edward Kyle is Professor of Metallurgy in the School of Chemical Engineering. After graduating from Cornell with the degree of ME in 1933, he did graduate work at Lehigh University and at the Massachusetts Institute of Technology, receiving the MS degree from the latter school in 1939. In July, 1946, he left M.I.T. where he was an associate professor in the field of metal processing and joined the faculty at Cornell.

Professor Kyle has served as research engineer for the Westinghouse Electric Corp. and as consultant for many industrial firms and government agencies. During the war he was Research Supervisor and Staff Assistant for the War Metallurgy Committee of the National Academy of Sciences. He is a member of Tau Beta Pi and Sigma Xi.

Prof. Kyle

Students operating the molding machine in the Foundry Laboratory.

knowledge of the localities whence the ores were obtained, familiarity with the process of manufacture, and with the nature of the materials employed by the metallurgist, coupled with a knowledge of the effects of various foreign substances upon the quality of the metal, may enable the engineer to judge with some accuracy what metal will best suit his purposes, and what will be likely to prove valueless. The engineer is also thus enabled to judge, should the purchased material prove defective, where the defect in quality originated, and to place the responsibility where it belongs."

Another work of similar character entitled *Materials of Construction* was first writeen by Professor A. P. Mills of the School of Civil Engineering at Cornell in 1915 and later revised by other authors after Professor Mills' death. This was a widely used text book in schools throughout the country. This work shows a correlation between metallographic structures and physical properties of metals.

From the standpoint of the theoretical study of the internal structure of metals, it has often been said that *Materials of Construction* written by the late Professor G. B. Upton of Sibley College in 1915 was ahead of its time. In his writing as well as in his elective advanced courses in physical metallurgy, Professor Upton was able to explain clearly the most complicated metallographic structures and trace their origin. Some of the concepts regarding reaction rates in the cooling of steels expressed in his book still serve as adequate explanations of heat treating effects.

Courses in Engineering Materials including some fundamental metallurgy were taught for many years by the late Professors H. Diederichs and A. C. Davis to all M.E., A.E. and E.E. students. These courses are now taught by Professors J. R. Moynihan and J. O. Jeffrey of the Engineering Materials Department of the Sibley School of Mechanical Engineering. Advanced courses in Engineering Materials Research and Applied Physical Metallurgy are also available in that school. Similar courses are also offered in the School of Civil Engineering by Professor H. H. Scofield although there is perhaps less emphasis required here on the strictly metallurgical aspects of the subject.

Cornell again leads the way in the field of engineering education with its new division of Metallurgical Engineering now being established in the School of Chemical Engineering.

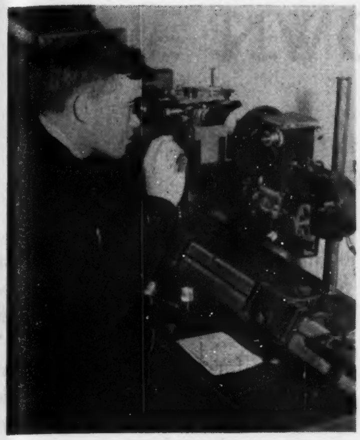
Chemistry, Chemical Engineering

In addition to the excellent work in the field of Engineering Materials, there were parallel developments in the chemical aspects of metallurgy in the Department of Chemistry and later in the School of Chemical Engineering by Professor C. W. Mason. In his book, *Handbook of Chemical Microscopy* written with Professor E. M. Chamot in 1930, can be found one of the best treatments of the metallurgical microscope and the fundamentals of crystallization. By applying the principles of physical chemistry to the study of metals, excellent courses in Metallography and Advanced Physical Metallurgy have been developed by Professor Mason. These courses were for many years prior to the war period required of mechanical engineering students electing the Metallurgy Option in that school, and have also been the nucleus of the Metallurgy and Metallography Option in the School of Chemical Engineering. The fundamental study of crystallization from the melt, the solid state, formation of solid solution, and eutectics in binary and ternary systems, made by Professor Mason became the basis of the educational program of the American Society for Metals in developing aids for the teaching of metallurgy.

Metallurgical Engineering

The dependence of industry on metallurgical engineering was undoubtedly emphasized by the many problems brought on by the recent war when substitute alloys were needed and new processes of manufacture were made necessary. The solution to these problems required the application of the fundamental laws of the physical and chemical behavior of metals and much attention was given to this most important approach to metallurgical engineering work.

To meet the future demands for men with this type of training, a division of Metallurgical Engineering is now being established in the School of Chemical Engineering under the direction of Dr. F. H. Rhodes. The development of this division at this time will make it possible to further enhance the prestige that Cornell already has in leading the way in the field of engineering education. The metallurgy and metallurgical engineering curricula of most schools have developed from the earlier days when min-



The metallograph used in studying the structure of metals at high magnifications in the Metallograph Laboratory in Olin Hall.

ing and the processes of extraction and refining were of primary importance. In attempting to keep pace with developments in the field of physical metallurgy, these schools have found it difficult to decrease the size and number of the traditional courses to make room for the teaching of the more modern and useful subjects required by the industry. With the standard five-year curriculum at Cornell, it will be possible to provide sufficient but limited instruction in the process metallurgy field, and still have the necessary time available for the fundamental work needed in chemistry, physics, mathematics and general studies, as well as in some of the fields of ferrous and non-ferrous metallurgy, foundry and welding technology, and physical metallurgy, metallography, radiography, and spectroscopy.

The association of this division with the School of Chemical Engineering is most fortunate. Thorough and fundamental training in chemistry, particularly physical chemistry, is common to both groups. The fundamentals of metallurgical calculations, metallurgical thermo-dynamics, and slag-metal-atmosphere reactions in molten metals have their origin in the chemical sciences.

Recent additions to the faculty of the School of Chemical Engineering include Asst. Prof. M. S. Burton who is assigned to the Metallurgical Engineering Division. He is a graduate of Worcester Polytechnic Institute and the Massachusetts Institute of Technology, and came to us from M.I.T. where he was engaged in teaching and research in the Department of Metallurgy.

The Foundry Industry

This industry has undergone a tremendous change in recent years as a result of new developments in metals and in casting processes. It has become increasingly important to exercise careful control of all operations in the foundry starting with the analysis of raw materials in the molding and melting departments, and ending with a most careful inspection of the finished product.

The Metallurgical Engineering Division at Cornell now has a very complete laboratory for the testing of foundry sands, particularly at elevated temperatures. For several years the American Foundrymen's Association has been sponsoring a research project on the properties of molding sands at elevated temperatures and as a result of this work, the University can be proud of its contribution to the solution of a problem which is very fundamental to the entire industry. In addition, our Foundry Laboratory is one of the best equipped college foundry laboratories in the country and plans are now being considered for improving these facilities and placing emphasis on a limited amount of special training in this field.

The foundry industry realizes that its future depends on the employment of more engineers in its shops and laboratories, and is prepared to provide the incentives necessary to get young engineering graduates to accept such positions. The metallurgical engineer will find many challenges to his technical ability in the solution of problems concerning sands, fluxes, metal melting, molding techniques, heat treatment, testing and inspection as applied to the production of sound castings of steel, iron, light metals and special alloys. The demands being made by the designers of gas turbines and other products will require that the metallurgist lead the way by developing new alloys.

The Welding Industry

Now that the early rush to use welding for all purposes has subsided, it is recognized that the proper use of the processes now developed and the discovery of new processes and materials to facilitate welding will depend on the guidance of trained engineers, particularly metallurgical engineers.

The development of alloys which have good weldability and a study of the welding characteristics of those already in common use are

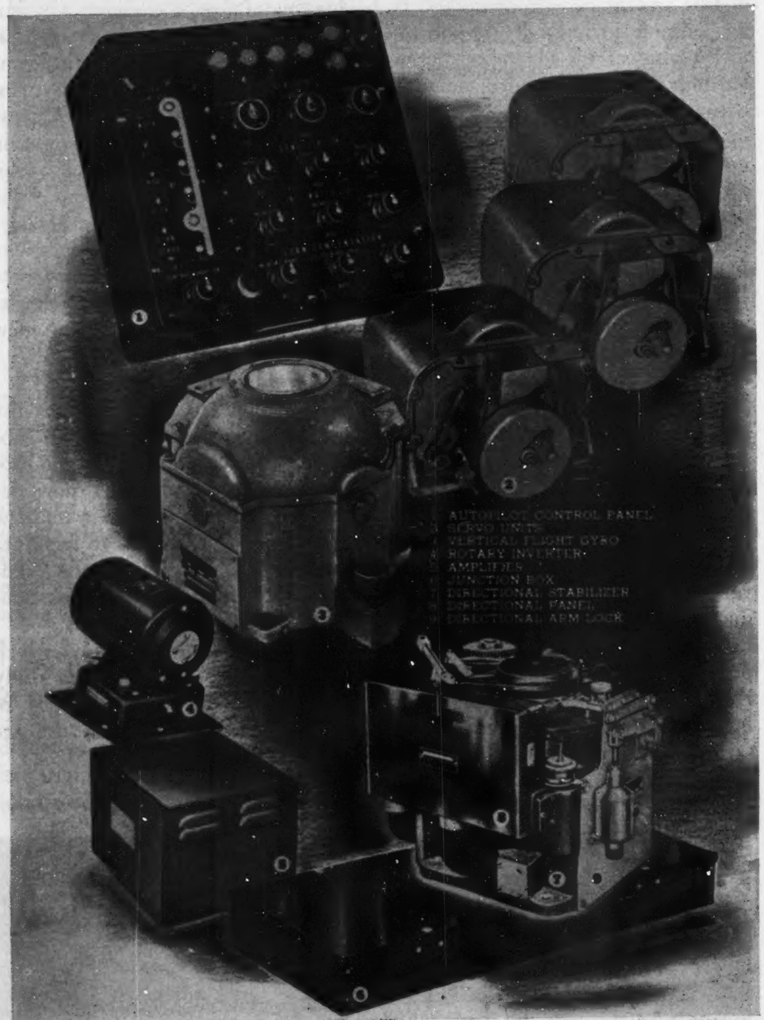
(Continued on page 38)

Students cleaning castings in the Wheelabrator Tumblast in the Foundry Laboratory.

A MIND OF ITS OWN

By CARL P. IRWIN, CE '49

Picture courtesy Minneapolis-Honeywell Regulator Co.



Long before it became apparent to most of the citizens of the United States that we were to became involved in World War II our leaders realized that we must build a powerful air force in the event of a possible attack. One of the greatest problems facing Army Air Force engineers at that time was the development of an improved method of high altitude precision bombing. The Norden bombsight was one of the answers to this problem, while the A.F.C.E. (Automatic Flight Control Equipment), was the other. Later called the C-1 autopilot, the A.F.C.E. is a device which keeps the plane on a continuous course determined by the human pilot.

Pilot and Autopilot

On a bomb run when the bombardier is aiming at his target the pilot's greatest problem is maintaining the airplane on a straight and level course. If this is not done the bombs will miss their mark, and the mission will be a failure. The precision of even the best human pilot is limited by the "reaction time" necessary for him to perceive that a correction in the ships attitude is necessary and then bring about that correction. As an example of the error this "reaction time" might introduce; a delay of 1/10 of a second in correcting a course deviation at 20,000 feet could cause the bombs to miss the target by as much as 1000 feet. The C-1 autopilot, on the other hand detects flight deviations the instant they occur and just as quickly operates the controls to correct them. It is capable of as many as 300 corrections a minute and in addition is not subject to fatigue or errors of judgment and muscle coordination, which cut down on a human pilot's efficiency.

Use for Autopilot

The C-1 autopilot was developed by the Minneapolis Honeywell Company for the Army Air Force for use with the Norden bombsight. Its primary function was to give the bombardier a stable platform from which to bomb by holding the ship in straight and level flight during the bomb run. However, it was also used to relieve pilot fatigue on long missions, and in combat demonstrated its adaptability by flying many planes out of danger when the human pilot was wounded.

The Makeup

The autopilot is made up of nine units: three servo units, a vertical flight gyroscope, a directional stabilizer (horizontal gyroscope), an amplifier, a rotary inverter, a junction box, and the autopilot control panel.

The servo units are small electric motors which mechanically drive

(Continued on page 34)

THE SEEING EYE OF TELEVISION

By HOWARD SANDERS, ChemE '47

All pictures courtesy of the Radio Corporation of America

Number One camera pans over to Holmes and Watson.

FADE IN HOLMES' STUDY.

Holmes, right of table, and Watson, left, are just finishing dinner. Mrs. Hudson is serving demitasse, cheese, and crackers.

Number Two camera dollies in for a close-up of Mrs. Hudson.

FADE MUSIC.

(Ready Number Three.)

Mrs. Hudson: And will you be wantin' anything else, Mr. Holmes?

Switch to Number Three on Holmes.

Holmes: No, thanks, Mrs. Hudson. This should satisfy the cravings of the inner man until breakfast, eh, Watson?

The demitasse, cheese, and crackers may satisfy the cravings of Sherlock Holmes, but will this television broadcast satisfy the cravings of the audience? The cameras have all been set in their proper places. The microphone booms have been lowered to provide the very best reception. The actors haven't muffed a cue. The lighting engineer, the technical director, and the property men have all done their utmost. But is the audience getting what it really wants? Will this program when reproduced on the screens of home receivers look as if it were being televised in a pea-soup fog, even though the script distinctly calls for the interior of Holmes' Baker Street flat? In other words, what about the clarity of the image?

Seeing In The Dark

The answer will largely depend upon the type of pick-up tube inside the television camera. If it is an image orthicon, the answer is simple. This new vacuum tube, one hundred times more sensitive than its predecessors, has given new, vastly improved sight to television cameras. Unique among pick-up tubes, it operates effectively no matter how poor the illumination, in fact, even in total darkness. Hence the audience sees what it wants to see—with a minimum of blurs, fuzzes, or halos. There is no questioning the fact that the image orthicon is today one of the most exciting inventions ever uncorked by television research.

The development of the image orthicon is actually the result of twenty years of pyramiding research. Without the accumulated engineering know-how which forms the basis of vacuum tube manufacture, without a fundamental knowledge of photoemission, electron optics, and electron multipliers, the image orthicon could never have come into being. The more specific groundwork for the development of the image orthicon was laid in the days immediately prior to the war. When its military importance was realized soon after Pearl Harbor, intensive research was undertaken at the RCA Laboratories, which have promoted the invention ever since its infancy. Under a grant from the Office of Scientific Research and Development, the work went ahead speedily toward the production of the tube in a form suitable for military use. Not until October of 1945, however, after security regulations were finally lifted, was the public allowed its first glimpse of this precious baby of wartime science.

Dr. Albert Rose

The principal credit for the development of the image orthicon goes to Dr. Albert Rose, who received his A.B. in 1931 and his Ph.D. in physics in 1935, both from Cornell University. During the intervening years, he served on the Cornell faculty as a teaching assistant. In 1935 Dr. Rose left the University to join the staff of the RCA Laboratories in Harrison, New Jer-

Dr. Albert Rose (left) and his co-workers examine their significant contribution to television — the Image Orthicon.

sey. There he conducted exhaustive studies into cathode-ray beam scanning, electron optics, and television sensitivities. All these investigations provided the undergirdings necessary for the work which was to follow. It was at the RCA Laboratories in Princeton, New Jersey, that, largely through his efforts, the image orthicon grew to its present form from an intangible germ of an idea in the minds of a few highly imaginative scientists.

From the outset, Dr. Rose and his associates realized that trying to obtain well-defined images with the older models, despite poor lighting, was like attempting to hatch an ostrich egg by rolling it into a hen house. Only by their adoption of an unique approach to the problem were Dr. Rose and his co-workers finally able to surmount the obstacles which so clearly faced them.

Past Performance

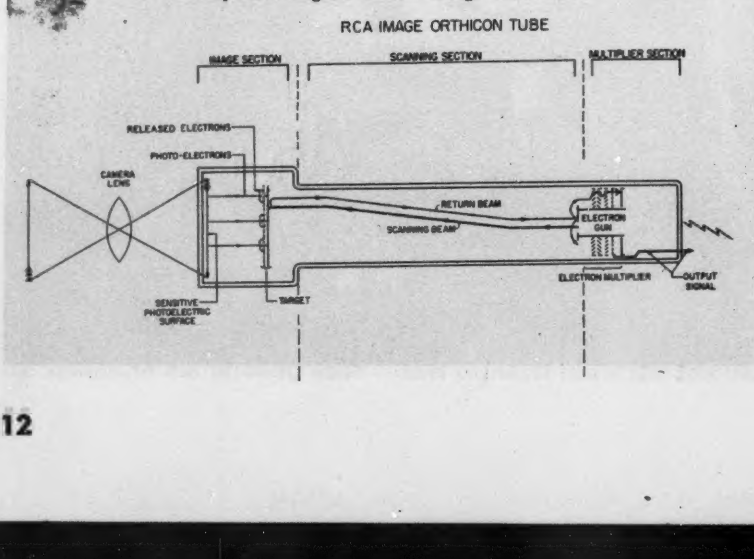
Television cameras prior to the war gave satisfactory results only under ideal lighting conditions, available principally in well-equipped studios. Hence the range of television broadcasting was sharply curtailed. Telecasts of football games, horse races, and other outdoor events were undertaken with a host of misgivings. As a general rule, the audience saw little more than an agglomeration of blurs. The pick-up tubes then in use were either the iconoscope or the orthicon. In these tubes the target and the photosensitive plate are the same element. Light is focused on the opaque target, called a mosaic, and by photoemission a charge pattern is built up equivalent to the intensity of the incident light. An independent electron beam scans this charged image directly. In the new design perfected by Dr. Rose, the photosensitive section is separate from the target plate, and the charge pattern, as will be seen later, is formed by secondary emission rather than by photoemission of the target. This is one of the crucial revisions made in the basic operating technique and one of those which accounts most directly for its improvement.

The Image Orthicon, representing ". . . the greatest single advancement made so far in field television," was developed by Dr. Albert Rose, A.B. '31.

Size and Shape

The image orthicon in size and shape is very similar to a large tubular flashlight. It is fifteen inches long and three inches in diameter at its widest section. Its essential elements are an electron-image surface, an improved orthicon-type scanning section, and an electron-multiplier section. The multiplier is very similar to the type of multiplier phototube which has in the past been used successfully in detecting the feeble light radiations from remote stars. In the image orthicon, this section amplifies the weak picture-image signals before further transmission. Here is another key to the superiority of the image orthicon.

Simplified diagram of the Image Orthicon.



Photocathode

In actual operation, the optical system of the image orthicon picks up the light from the scene under observation and focuses it on the photosensitive surface within the tube. A semi-transparent photocathode is used which permits electrons to be released from the side opposite to that facing the light source. Electrons emitted by each portion of the illuminated surface are in direct proportion to the intensity of the light striking it. This surface consists of cesium oxide grains which act like thousands of tiny photocells, highly sensitive to a wide range of light frequencies.

Secondary Emission

A grid placed directly behind the photosensitive surface causes the stream of electrons to flow from the back of the photocathode to a neighboring target. In reaching the target, essentially straight-line paths parallel to the axis of the tube are taken by the impelled electrons. The violent bombardment of the target by these electrons causes the target to release additional or secondary electrons. Local deficiencies of electrons arise on the target because of the loss of these secondary negative particles. Consequently, a pattern of positive charges is set up on the target corresponding exactly to the light image originally focused on the photosensitive surface. The target itself consists of a thin sheet of low-resistivity glass which allows charges deposited on either side to be neutralized within the frametime of one-thirtieth of a second.

Electron Scanning

At the extreme opposite end of the tube, an independent stream of electrons is projected by a conventional electron gun. The electrons emitted in this manner are initially boiled off the cathode by a separate heating element. Originating as a random cloud, these electrons are

At the right is a close-up of an RCA television camera. Since it is equipped with an image orthicon pick-up tube, it is by far the most versatile camera of its type.


RCA
Television

rapidly concentrated into a fine beam smaller than the head of a pin. The beam, magnetically controlled, scans the target at the front end of the tube in an orderly sequence, line by line. This scanning process is analagous to the manner in which the reader's eye follows the printed page, left to right, from top to bottom. Four hundred such lines are traced by the beam every one-thirtieth of a second.

Electron Gun

The tube is so constructed electrically that the electrons aimed at the target are normally slowed down in their course, stop just short of the target, reverse their path and return to the electron gun. However, if a projected electron comes within the influence of a positively charged portion of the target, it is at once drawn into the target and thus never makes the reverse path back to the electron gun. When a sufficient number of such electrons are deposited in a positively charged region, the local charge on the target is neutralized. Then once again the electrons make the complete traverse back to the electron gun without interference. All this occurs in the merest fraction of a second. Of course, in the meanwhile, a new charge pattern will have been set up on the target under the influence of more secondary electrons emitted on the opposite side.

Because some of the electrons fired by the electron gun are lost to the target, the electron density of the returning beam varies in exact correspondence with the distribution of positive charges on the target. This distribution, in turn, is based upon the light and dark composition of the light image imposed initially on the photosensitive surface.

The Dynode Does It

The returning beam is sent to a cascade multiplier, composed of a series of dynodes at the end of the tube. The principle of secondary emission used so effectively at the target is also employed as the fundamental basis of the multiplier section. Because of secondary emission, when electrons are directed against any one of the dynodes, two or more electrons are emitted for each electron that bombards it. In turn, these electrons are shot against an adjacent dynode which, like the previous plate, releases more electrons than initially strike it. This cascading action produced by a series of dynodes provides a substantial increase in the number of output electrons.

Variable Amplification

At low levels of incident illumination, in the region of one hundredth of a candle per square foot, the multiplier has an amplification factor of about one hundred. That is, for

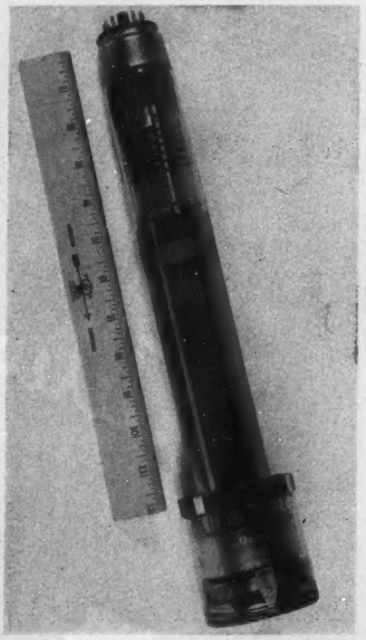


Image orthicon tube

each electron entering the multiplier one hundred are recovered at the outlet. Under conditions of greater illumination, the amplification automatically diminishes, an effect similar to automatic volume control on home radio receivers.

The improved performance of the image orthicon is the result of several distinctly new design features. Because the functions of scanning are isolated from those of converting the light image into an electron image, each element may be designed for optimum performance and thus for maximum sensitivity. Materials with photosensitivities several times higher than obtainable with the type of insulated surfaces found in iconoscopes may be used for the photocathode. No compromises are necessary to produce at the same time an efficient target. Furthermore, the emission of secondary electrons by the target multiplies the effect of the photoelectrons released by the photoelectrode. The cumulative result of both these changes creates a five-fold increase in sensitivity.

Multiplier Section

By placing the multiplier section inside the tube, the image signal is amplified above the noise level before it has a chance to become hashed up by electrical interference in outside conductors. In addition, the automatic amplification control embodied in the multiplier section has the desirable effect of keeping fairly uniform the overall levels of illumination on receiver screens, despite sudden fluctuations in image light intensity received by the camera. Also should one section of the camera image be more brilliantly illuminated than another, this automatic gain control tends to accentuate the dim regions and suppress the glare. Consequently, a picture results with more uniform brightness, just that much more pleasant to observe.

Infra-Red

Recent tests show that the light of a single match is sufficient to operate the image orthicon effectively. In absolute darkness, an object, if bathed in invisible infra-red rays, appears on a receiver screen as if it were illuminated by broad daylight. In fact, so sensitive is the image orthicon to infra-red that this high response can at times constitute an actual drawback. When televising most outdoor scenes, particularly those characterized by an abundance of living green foliage, it is desirable to use an optical filter to attenuate the infra-red radiation.

Pick-up Range

Of greatest practical importance, the image orthicon extends the television pick-up range to nearly all scenes of visual interest, no matter how remote, no matter how poorly illuminated. It yields foreground and background detail previously

(*Continued on page 28*)

Cornell Nobel Winners

JAMES B. SUMNER

JOHN R. MOTT

James B. Sumner

Another Cornellian who was "in the news" last year was Dr. James B. Sumner, professor of bio-chemistry here. Professor Sumner received complete recognition for his isolation of enzymes when he was awarded half of the 1946 Nobel Prize in chemistry. The second half will be divided between Drs. J. H. Northrup and W. M. Stanley, both of the Rockefeller Institute for Medical Research, Princeton, N. J.

The story of Professor Sumner's interest in enzymes goes back to the days when he was a student at Harvard. Sumner had lost an arm in a hunting accident when he was seventeen, and the Harvard faculty advised him to undertake a course in engineering or law, but Sumner decided upon chemistry and stuck fast to his decision in spite of the handicap he would have in the laboratory. In 1912, he heard Professor Henderson of the Harvard Medical School declare that no enzyme would ever be isolated until some entirely new method for concentrating them could be devised. This was a challenge to James Sumner, and fifteen years later he disproved the statement of his old professor.

Enzymes are organic catalysts which make possible the decomposition of foods into more basic elements for consumption by living things. For instance, starch may be broken down by the actions of acid and high temperatures, but enzymes make possible this breakdown at body temperatures. In other words, enzymes make life possible.

Like so many other scientific discoveries, it took years of constant work by Professor Sumner to succeed in what he had started out to do. The first enzyme to be isolated and crystallized was urease, jackbeans having been the source of urease used by Professor Sumner. Some of the difficulties encountered were devising a new method for treating the product obtained from the jackbean, finding jackbeans with a high urease content (Sumner even had the King of Belgium order the natives of the Belgian Congo to pick jackbeans for him), and finding a firm willing to grind the jackbeans into a fine powder (nobody wanted the job because some people had been poisoned by the dust in the process). Professor Sumner temporarily abandoned work several times for other projects, but in 1926, he finally isolated and crystallized urease. His biggest difficulty then appeared: how to convince anyone that he actually had succeeded. His original experiments with isolated urease are today held as completely valid, and his subsequent experiments with urease and other enzymes have substantiated his efforts greatly, but at the time of the original discovery, the celebrated German school of bio-chemistry held fast to a theory that enzymes are not any of the chemical compounds known to chemists. and resting on this assumption, Professor Sumner's work was invalid. However, these scientists could not afford any satisfactory explanation as to what Sumner had done, and they repeated Sumner's process and published entirely fallacious results. The general attitude toward Professor Sumner was, "Why do you think you can isolate an enzyme when so many of our great German chemists have failed?"

In 1934, Waldschmidt-Leitz made a survey on the work of enzymes and concluded that Sumner's work was just a further breakdown of the enzyme "carrier." From an article by Sumner in the Journal of Chemical Education, June 1937: "Presumably he meant that urease, on being wholly deprived of a carrier to perch on, cannot exist." After the 1934 statement by the German school, the work on crystalline urease and other enzymes has been generally accepted.

Professor Sumner spent most of his time here at Cornell in teaching and research. Originally a professor of bio-chemistry in the Medical College when the first year of medical school was taught here in Ithaca, he was shifted to Zoology and later to Animal Husbandry, when the Medical College first year was transferred to New York. In 1942, he was, in addition, made a member of the faculty of the School of Nutrition.

He was born in Canton, Massachusetts, in 1887, and later received his AB, MA, and PhD degrees from Harvard in 1910, 1913, and 1914. Professor Sumner is definitely an "outdoor man," having spent many summers in the north woods. He enjoys skiing, sailing, fishing, shooting, and is considered an excellent tennis player. He has traveled in Western Europe many times and has studied there. He has received several fellowships including a Rockefeller grant. In 1937, he received the Sheele Medal in Stockholm.

John R. Mott

Although this is primarily an engineering magazine, we feel that John R. Mott, Cornell '88, distinguished in his non-scientific field, deserves mention here along with Professor Sumner. Dr. Mott won a Nobel prize for peace last year in recognition of his work in the Y.M.C.A.

(Continued on page 36)

Mr. Mott

News of the College

NEW MATERIALS UNITS

Materials Testing

A new materials testing unit for the College of Engineering at Cornell, made possible by the contributions of corporations, alumni, and other friends of the University totaling $574,213, will be erected east of the Old Armory as soon as conditions permit.

This unit is one of the five which will eventually form the Materials and Metallurgy Laboratory in the new Engineering College development at the south end of campus. Olin Hall of Chemical Engineering, completed in 1941, is the first structure in the new development.

Most of the testing equipment, at present scattered in various existing engineering buildings, will be installed in the new laboratory as well as several new pieces of equipment including a large testing machine of several million pounds capacity and greatly improved features of rigidity and sensitivity. Dean Hollister pointed out that, given the opportunity to test larger beams, columns, and frames that can be handled by present equipment, the college will expand the range of research that can be undertaken and give students a broader background of professional knowledge.

Metal Processing

A new folder prepared by the University describes the proposed Metal Processing Unit of the new Materials and Metallurgy Laboratory. Since funds are already available for a Materials Testing Unit it is hoped that the Metal Processing Unit may be erected at the same time.

The Metal Processing Unit will be one of the five wings of the new Laboratory which have been proposed. In addition to the Materials Testing and Metal Processing Units there will be the Foundry, the Nonmetallic Laboratory, and the Applied Metallurgy Laboratory. The Old Armory will have to be demolished to make room for the completed building.

The next projected structure will house the pattern shop and machine shop, both enlarged from their present facilities in Rand Hall, with the addition of new equipment that has already been obtained. There will be a Gauge Laboratory with latest devices for precision control of industrial manufacturing operations, facilities for which have been arranged for with the Army Ordnance Department; there will be x-ray and other apparatus for inspection of metal products. In addition to facilities for instruction, special research equipment will be installed for studying fundamental problems in stresses, metallurgy, cutting techniques, and tool design, along with efficient plant organization for manufacture of metal products.

Alumni may obtain the folder on the Metal Processing Unit upon request to Vice-President Hollister, Olin Hall, Ithaca.

Coordinator

A broadening of International Nickel's cooperation with universities and colleges in the United States and Canada in the field of engineering education through the distribution of technical literature has been announced.

The new program will make available useful material for classroom instruction in training students in scientific fields. It has been offered to, and accepted by, a number of important institutions in the United States and Canada which give accredited courses in mining, metallurgy, chemical engineering and one or more other engineering courses. As rapidly as possible the program will be offered to all engineering schools. Peter E. Kyle, Professor of Metallurgy, will be coordinator of this program for Cornell University.

The Development and Research Division will furnish to each institution an exhibit containing approximately 50 specimens of nickel-containing materials; a portable metals identification kit containing approximately 35 specimens of important metals and alloys for qualitative identification of metals and alloys (spot-testing); literature and other technical and practical information concerning nickel and its alloys, and other data. Motion pictures of the company's mining, smelting and refining operations will be made available.

ASCE Meeting

Dean S. C. Hollister and eleven members of the School of Civil Engineering faculty at Cornell attended the 94th annual meeting of the American Society of Civil Engineers from January 15 to 18 in New York City.

In addition to Dean Hollister, the group included Director W. L. Malcolm and Professors D. J. Belcher, Marvin Bogema, Carl Crandall, D. E. Donley, H. M. Gifft, R. M. Mains, E. W. Schoder, F. J. Spry, C. L. Walker, and George Winter. Dean Hollister is a director of ASCE.

Dean Hollister who is a retiring member of the Board of Directors of the Society attended a meeting of that body in New York preceding the meeting proper.

New Director

Dr. Robert R. Wilson, eminent young physicist who is presently engaged in developing the new Harvard University cyclotron, has been appointed professor of physics and director of the new Laboratory of Nuclear Studies at Cornell University.

He will replace Dr. Robert F. Bacher as director of the laboratory until the latter's expected return in 1952 from his duties on the Atomic Energy Commission.

Among his colleagues, the new director is known as one of the outstanding nuclear physicists of his academic generation. The young scientist, born in 1914, was in charge of the experimental work of the Princeton branch of the atomic energy project during 1941-43, and was head of the Division of Experimental Physics at the Los Alamos Laboratory of the Manhattan Project.

Before assuming his recent duties of developing the new cyclotron at Harvard, he studied the developments of high energy particle accelerators for six months at the University of California.

PROFILES

Alfred L. Boegehold, M.E. '15

Alfred L. Boegehold entered Cornell in 1911, after graduation from Mt. Vernon, (N.Y.) High School. Because of high marks in courses in mathematics and other scientific subjects, he elected a course in mechanical engineering. Like most would-be engineers studying today, Mr. Boegehold found college courses a tough proposition.

He was a member of the Theta Chi fraternity and his principle extracurricular activity was rowing. In his freshman year he rowed bow on the second freshman eight. In the sophomore year he was No. 7 on the Sibley crew which won the intercollegiate championship race, and in the junior year he was No. 3 on the junior varsity crew which represented Cornell in the first junior varsity race held at Poughkeepsie in 1914, helping them to take first place from Columbia, Syracuse and Pennsylvania.

After graduating in 1915 with an ME degree, he accepted a job with the Remington Arms and Ammunition Co. in Bridgeport, Connecticut, who were then engaged in manufacturing Russian and French rifles and British bayonets. While there he obtained experience in a large variety of machine operations in connection with the manufacture of these firearms. Later, he advanced to the time study and experimental engineering department where experience in time study and rate setting was obtained. While working in the Department of Tests he became definitely interested in the subject of metallography. His interest in this subject was so great that he studied a number of texts on the subject in an effort to become as proficient as possible. This work led directly to experimental work in the heat treating of steel and the writing of specifications for materials and heat treatment processes. After a year of this kind of work, Boegehold was convinced that his lifework was metallurgy.

Mr. Harry M. Williams, who had been the engineer of tests at the Remington Arms and Ammunitions Co. during the time Boegehold became interested in metallurgy and for whom he worked, offered him a position at General Motors Research Laboratories in Dayton, Ohio. After five years of a variety of metallurgical activities in this organization, the General Motors Research Laboratories moved to Detroit, Michigan, and at that time, since Mr. Williams stayed in Dayton, Mr. Boegehold was assigned to his position as Head of the Metallurgy Dept. of Research Laboratories Division of General Motors, which he has held ever since.

As the result of a study of pig iron, which revealed some interesting relationships between the characteristics of pig iron and the nature of cast iron and malleable iron made therefrom, the American Foundrymens' Association awarded him a prize in 1929 called the J. H. Whiting Prize. Later on, in 1942, the same society awarded him the J. H. Whiting Gold Medal in recognition of other technical papers on cast iron and for activity on technical committees of the society.

Mr. Boegehold was Secretary-Treasurer of the Detroit Chapter of the American Society for Metals in 1937; was the Campbell Memorial Lecturer in 1938; and became the Chairman of the Detroit Chapter of the American Society for Metals in 1938. He is Trustee of the American Society for Metals, and a member of the American Institute of Mining and Metallurgical Engineers and the Executive Committee of the Iron and Steel Institute.

In addition to the study of pig iron, some of the many metallurgical projects which have been carried on under A. L. Boegehold's leadership were the development of a method for making brake drums for automobiles, of a bearing which is not susceptible to corrosion by acids, of a process for completing the annealing of malleable iron in 30 hours where it had formerly taken over 100 hours and of the Jominy Hardenability Test for testing the hardening power of steel, which is used extensively all over the world. It is with justifiable pride that fellow Cornellians view Alfred L. Boegehold's outstanding contributions to metallurgy, which have not only been in the form of research on many phases of metallurgy, but have also included active participation in and leadership of many metallurgical societies.

Edgar H. Dix, M.M.E. '16

Chief Metallurgist and Assistant Director of Research of the Aluminum Research Laboratories of the Aluminum Company of America at New Kensington, Pa., Edgar H. Dix, Jr. MME '16 is the inventor of the alclad high strength aluminum alloy sheet in use on the majority of U. S. military and transport planes, and is also the author of numerous technical papers and articles for scientific organizations and publications.

Although he received his ME degree specializing in electrical engineering in 1914 at Cornell, his appointment as an instructor in the Junior Engineering Laboratory

(*Continued on page* 42)

PROMINENT

Jack

Jack Drew, ChemE

Getting biographical information out of Jack Drew is very much like drawing teeth; however, we managed to extract a little data, along with many protestations: "I don't know what you can write about me; I've never done anything." What do you call getting to the fifth year in Chem.E., Jack?

"If anybody cares, I was born August 11, 1924, in Baltimore, Maryland; my family wandered around a little—Atlantic City, New Jersey; Newton Highlands, Massachusetts; and finally East Orange, N. J. I went to Clifford Scott High School—never what you'd call a big wheel. Well, I played varsity table tennis." (Mr. Drew was also a member of the Chemistry Club, News Editor of the school newspaper, the *Bagpipe,* and was on the varsity tennis team.) "Forget about that varsity tennis; I was number eleven on the squad, and they never played more than the first six."

In September, 1942, Mr. Drew went to the Cornell Chem.E. School on a McMullen Scholarship. Here he was initiated into Tau Kappa Epsilon fraternity, and got a term and a half of school before going into the army.

"My army career, to say the least, was undistinguished. The usual thing, you know; Fort Dix for shots and clothes—they had a rough time getting shoes for me—and then Fort Bragg for basic training. No, I wasn't in Hargrove's battery, but I can remember lots of times when the rest of the guys were smoking after-dinner cigarettes on the barrack steps while I raked C-4-2's battery street from the downstream to the upstream end. Good old Sergeant Pareso!" Jack's running battle with the Army was lost by default when he was CDD'd in November, 1943.

"Came back in the middle of the term and picked up just where I left off. Haven't done much since then except sleep and work, and go to an occasional party."

Not much, unless you consider becoming a member of Al-Djebar, A.I.Chem.E.—he was president of the Cornell chapter in the school year 1945-46—and Alpha Chi Sigma, the professional chemist's fraternity, of which he was vice-president in his junior year.

In the summers of 1945 and 1946, he took busman's holidays as a still

(Continued on page 26)

Charles Mallery, EE

Last summer one of Cornell's Electrical Engineers went on four canoe trips in the Adirondacks, spent a week packing supplies to Johns Brook Lodge on a burro, and finished off with a week of hiking in the Mount Marcy region. So, judging from his pre-war standard of two canoe trips and a week of hiking, his expense-paid travels in England, Germany, the Philippines, and Japan haven't quieted his feet down a bit.

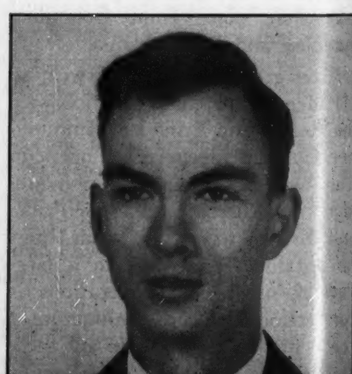
His name is Chuck Mallery, and he hails from Albany. (Albany finally discovered where he was and sent him a scholarship in addition to the one he already had). Back at Cornell since the spring term of '46, he is continuing with his power option. This takes plenty of time, but knowing Chuck, it would have to take lots more before he'd forget the outdoors for a four month stretch. Now president of the Outing Club (the outfit knows more about the cow paths of Tompkins County than the cows do), Chuck has been an active member since his frosh year in 1941, except for some time spent in operating radio relay stations for the Army. He came back wearing a "Limey" battle jacket fitted with red buttons, but still prefers an ancient green flannel shirt with an only slightly younger Club emblem on it.

Chuck's prize possession is his album of hiking and camping pictures. With him, it's not a matter of taking lots of pictures and filling albums; he's really a connoisseur, and only the best go in his album. His eye for a candid shot is a little too good for us; some of the pictures we wish he didn't have.

In spite of his status as an Electrical Engineer, president of the Outing Club, member of Eta Kappa Nu, and treasurer of the Student Branch of the American Institute of Electrical Engineers, he still hasn't forgotten an old love. Every once in awhile he "does a little scouting," as he says, and takes a bunch of Ithaca's youngsters for a hike. He's an Eagle Scout himself and gets a big kick ("charge" to him) out of showing them how to string up a pot over the fire and get the "glop" cooking.

If in the future, you should see a lineman out stringing wires, and whistling while he works, you'll know its Chuck, combining his love of the outdoors with his knowledge of electrical engineering.

Chuck



ENGINEERS

Louis R. Tyler, CE

Although Lou Tyler is now a regular habitue of Lincoln Hall, he arrived there only after traveling a roundabout route which included two years at Notre Dame as an electrical engineer.

It all started just twenty-one years ago in Drexel Hill, Pennsylvania, a suburb of Philadelphia. Lou's first interests ran along musical lines, and after taking drum lessons, he became a permanent fixture of his junior high school band. During his last year in junior high, he spent most of his time backstage in the school auditorium as stage manager for all school programs, and he used this experience when he entered Upper Darby Senior High by acting as stage manager for his senior class play. He also found time to manage the track team for three years and to play intramural soccer and basketball as well. Both the National Junior Honorary Society and Hi-Y elected him a member.

In March 1943, during his last year in high school, he enlisted in the Marine V-12 program. About a month after graduation, he received his orders to report to the University of Notre Dame on July 1. While the Fighting Irish were marking up another championship football team, Lou was being initiated by college professors and drill sergeants simultaneously. During his four terms at Notre Dame, Lou put in quite a bit of time with both the university and the V-12 band. Then, in November 1944, he was transferred here to Cornell, just in time for those three long months of snow and the accompanying winter sports.

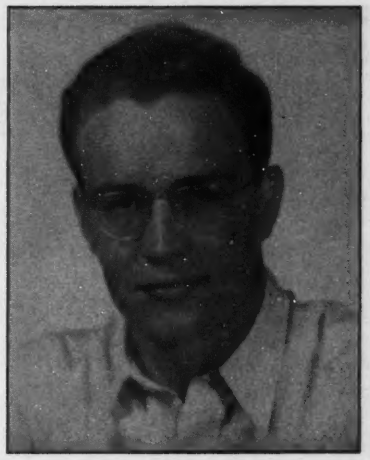
The Marine Corps had originally decided to make an E.E. out of Lou and he had no say in the matter. However, he found civil engineering more to his liking, and with a little persuasion, he managed to get himself transferred into the C.E. school after one semester here at Cornell. In the Fall of 1945, he was taken into another honorary society, Chi Epsilon. He says he "kept on the good side of the Marine Corps" long enough to receive his commission last March, after which he was placed on inactive duty. He returned to Cornell immediately.

After a summer of rest and relaxation in Wisconsin with his brother, Lou is back for his final term, and is busying himself both as Vice-President of the Student Chapter of the A.S.C.E. and as an officer of Chi Epsilon. Upon graduation in February, he expects to take a position in Arabia in the structural design department of an oil company subsidiary located there. He won't have to worry about these cold Ithaca winters, but, he says, "there must be an easier way to get a suntan!"

Lou

Eugene S. Carlson, AEME

Gene Carlson arrived on the Hill in July of 1943, fresh from prep school. He was graduated from University School in Shaker Heights, Ohio, hardly a month before, and replete with a McMullen Scholarship, he delved into the intracacies of mechanical engineering, which, he was assured, would become easier as time went by. Of this assurance, Gene says, "I don't want to comment further on that statement beyond saying that some people have it and then again some people don't." Gene's subsequent career proved that he did.



Gene

Gene believes that one of the finest things to be gained from college is a well-rounded extra-curricular life, and he got off to a good start immediately. In his first term, he became a member of the Men's House Committee at Willard Straight, as well as becoming a pledge to Phi Delta Theta. His fraternity elected him its President in the Spring of 1945, and during that term, he helped to reestablish the Interfraternity Council, then known as the Interim Council. He also took part in the Interfraternity Conference, composed of undergraduate fraternity men, University representatives, and Alumni representatives, which set about to reestablish the fraternity system at Cornell on a sounder and more enduring basis.

At one time or another, Gene became affiliated with the Cornell Daily Sun, with what he calls "the honorary social society of Kappa Beta Phi, the Sibley Society of Atmos, to which he was elected Vice-President this term, and the American Society of Mechanical Engineers."

Lest the above recitation of serious labors give the wrong impression, Gene hastens to add, "While I am a firm believer in the forces of temperance et al, I nevertheless am a firm devotee of that hail in-

(*Continued on page* 26)

Recent Developments In Engineering

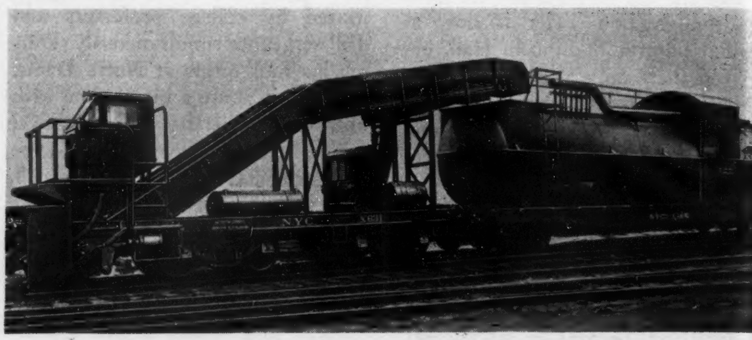
Techni-Briefs

New Snow Remover

Faced with the problem of removing snow from railroad tracks, the Barber-Greene Co. has designed a new piece of snow removal equipment. Instead of pushing the snow to one side and covering up the adjourning tracks, this piece of equipment virtually eats up all the snow.

Picked by a conveyor belt at the forward end, the snow is dumped into a large tank in the rear containing boiling water. Two tanks are employed in this system. The small one is first filled with water which is brought to the boiling point by injecting steam. Then water is allowed to flow into the large tank so that water level of both tanks is about two feet. As the snow is deposited in the large tank it melts and fills both tanks. At this point it is necessary to dump the water into a convenient drain or catch basin. Water is retained in the small tank, reheated with steam, and the process is repeated.

Motive power is supplied by a locomotive which pushes the snow remover. Experiments show that this system is 70% cheaper than the older methods commonly employed.



—Courtesy Barber-Greene Co.

The new snow removal equipment for removing snow from railroad tracks.

Giant Telescope

Delayed during the war, the work on the 200 inch telescope on Mount Palomar in Calfiornia has begun again and is reaching completion. This instrument will enable astronomers to investigate areas as much as a billion light years out into space.

Despite its enormous size, this telescope has been built with the closest possible tolerance. The tolerance worked to on the 317,000 pound horse-shoe bearing for the telescope, gives an idea of the precision with which the parts were built. While boring the center of this bearing to a diameter of 44 feet, the engineers were troubled by the expansion of the piece due to the sunlight entering the shop. In the later part of the afternoons, this heat would expand the bearing as much as thirteen thousandths of an inch. As the boring was to be bored to a tolerance of five thousandths of an inch, a solution of this problem had to be found. The Westinghouse engineers' best solution was a "sun-bonnet' which eliminated 50% of the expansion due to the heat.

After the bearing was bored, it was literally pressed out of shape. This was done so that the weight of the telescope would again restore it to a near perfect circle. The bearing, which runs on oil pads, reduces the friction to 1/600 of that which roller bearings would produce if they were used. Thus an engine of one-half horsepower could turn the 500-ton mounting for the telescope.

4000 Times Sweeter

In the near future you may be able to measure the sugar for your coffee in grains, rather than by the teaspoon. This may come true by the use of N-Propozy, a new sweetening agent developed during the war by a Dutchman. As compared to saccharin which is only 200 to 700 times as sweet as cane sugar, the new substitute is 4,000 times sweeter than natural sugar. Already in use in Europe, the American patent has now been applied for. Its one drawback is that it is only slightly soluble in water, but even when diluted with milk sugar, it is stronger than any other sweetening agent. If a few grains of this substance were put on the tongue, its taste would remain for half an hour.

Air In Concrete

A system of trapping air in concrete, already tested on some roads, may soon be applied to concrete structures. By using pine resins, animal or vegetable oils and fats, or other saponifiable substances, air bubbles can be formed in concrete. These spheroids of air greatly increase the resistance of the concrete to chemical action with salts used in de-icing walks and decrease the amount of frost heaves. The loss in rigidity is more than compensated for by the greater uniformity of the bonding in the concrete.

Uses of Natural Gas

A surprising number of uses for natural gas have been found in recent years and are not being greatly employed. It is used to make soaps, thin resins, insecticides, and a synthetic gasoline.

(*Continued on page* 26)

The dynamometer shown at the right is used to simulate actual landing conditions for the landing gear to be used in future aircraft. It is the largest testing machine of its type in the world.

—Courtesy Westinghouse

Cornell Society of Engineers

107 EAST 48TH STREET 1946-1947 NEW YORK 17, N. Y.

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"The objects of this Society are to promote the welfare of the College of Engineering at Cornell University, its graduates and former students and to establish a closer relationship between the college and the alumni."

President's Message

I have been thinking recently about the extent to which engineering as a profession has expanded in the last seventy-five years, so that it now reaches into every phase of our lives.

This reflection was brought about by my coming across some engineering books of my father's at about the time I was attending a convention of one of the large engineering societies.

To the world of seventy-five years ago engineering was primarily boilers, engines, pumps, gears and levers. Steam was king of motive power and huge Corliss engines with majestic fly wheels supplied energy through an elaborate system of belts to the machines to be driven. I remember the tunnel where a little boy was allowed to go for a rare moment now and then and literally have his hair stand on end from the static emanating from the 36" belt carrying power under the road to a vertical shaft in the spinning mill! Here various belts fed the power off until it finally dissipated itself in the deafening whirr of thousands of spindles.

Then the problems of the engineers were leaking pipes, broken belts and babbitt bearings that frequently burned out—usually at the most inopportune time.

And how different the machine shops of that period! Then overhead belts flapped and screeched as machine loads were applied. Fine work was done but only those with years of training in particular skills could acquire the coveted title of "toolmaker." Each reader can supply, for contrast, his own picture of some modern factory with which he is familiar.

Steam is still a great servant of mankind, but to it has been added the vast versatility of electric and hydraulic power. In putting to work these new forces, undreamed-of benefits have occurred to all. Competition between these great prime movers has led engineers to ever strive for greater efficiency. This has opened horizon after horizon of new uses. Each new use has stirred scientists on to further study and exploration, so now a score of technical societies are needed through which engineers may reveal their specialized findings.

As each type of engineering profession matures, greater specialization seems to occur so that we find the oldest societies with many branches and sections. The technical studies must delve into considerations which were unheard-of seventy-five years ago. This reaches the extent where one of the societies recently gave one of its highest awards for a Study and Analysis of Resonant Vibration in Pipes.

That, of course, is one of the great opportunities and, at the same time, great problems of the young engineers in these times—keeping up with what is being revealed and published is a tremendous task. But here is where I think it is easier for Cornellians than for many others.

With our great heritage in the pioneer work done in electrical, mechanical, civil and industrial engineering, students are brought closer to an understanding of the responsibility we feel for carrying our chosen profession to even greater heights of service to mankind.

ROBERT B. LEA

ALUMNI NEWS

Alexander S. Eisenbrandt C.E. '20 has been appointed budget accountant for the industrial electronics and x-ray divisions of Westinghouse Electric Corp. He joined the accounting department in 1942 after being in real estate development and small home construction business. Before that he had served as a distributor in the Baltimore Washington territory for national radio and phonograph manufacturing companies. He resides at 2226 Crest Road, Baltimore.

J. Thompson Brown, '03, has resigned as a vice-president and member of the Executive Committee of E. I. DuPont de Nemours and Company. He is still serving as a member of the company's Finance Committee, and remains on the Board of Directors.

Francis H. Scheetz B.Chem. '16 now associated with the law firm of Evans, Bayard, and Frick in Philadelphia has been named chairman of the Cornell Alumni Committee on Bequests and Annuities. He also serves as chairman of the class of 1916 Fiscal Committee.

A gift of $1,000 from **Cyrus D. Backus** E.E. '96 of Silver Spring, Md. has been received by the University. Mr. Backus is a member of the American Institute of Electrical Engineers, Institute of Radio Engineers, Cosmos Club of Washington, Cornell Clubs of Washington and New York, and a fellow in the American Association for the Advancement of Science. He is serving as a patent attorney with International Telephone and Telegraph Corp.

Edward E. Lipinski C.E. '14 formerly with James Stewart and Company has associated with J. H. Williams and Company, General Contractors, 1122 Cathedral Street, Baltimore, as Vice President.

Discharged from the Navy in June, **Francis Gifford** BME '42 has become a test engineer at Chance-Vought Aircraft, Stratford, Connecticut.

Arthur F. Glasser who received a degree in C.E. '36, and then decided to go into the ministry, sailed for China November 22 to become connected with the China Inland Mission Service. Mr. Glasser served as a chaplain in the Marine Corps during the war and has recently had published the book he has written about his experience, *And Some Believed.*

As an operations engineer **Frederic C. Burton** C.E. '42, recently joined the Texas Company and is connected with the African Division of the Foreign Sales Department.

Former Colonel **Howard W. Dix,** M.E. '11 now out of the army, has returned to his patent law partnership of Emery, Varney, Whittemore, and Dix. Mr. Dix has spent the last five years in Ordnance and the O.S.S. on patent and research matters.

Robert M. Gifford BS in AE(EE) '39 is being transferred from the Schenectady to the Cleveland office of the General Electric Co. as a motor specialist. He reports that **J. E. Godfrey Jr.** '39, has been in Schenectady for the last four months with the same company.

Now general superintendent of the film quality control department of Ansco division of General Aniline and Film Corp., **Karl Pechmann** B.Chem.E. '38 of Binghamton was transferred October 1st from the research laboratory.

Spencer Kellogg II ME '37 is in charge of aircraft flight instrument development at Sperry Gyroscope Co.

Arlington W. Clark E.E. '25 '26 has been appointed general manager of Snap-on Tools of Canada, Ltd. to be in charge of all sales, production and district functions of the company's home office and factory at Long Branch, Ontario. He has resigned as managing director of Black and Decker Manufacturing Co. Ltd., a position he has held since 1934. Last year Clark served as chairman of the district conference committee for the 168th Rotary district convention.

Edward A. Reed E.E. '31 of Flint, Michigan is head of die engineering and faculty chairman of the Alumni Engineering Association at the General Motor Institute, central training agency of General Motors Corp.

Edward D. Luque E.E. '23 of Hamburgo 306, Mexico City is assistant general manager of operations for Industria Electrica de Mexico and has been working on the layout of their new factory to be erected near Mexico City. The factory, which is to be used for the manufacture of electrical equipment under Westinghouse patents and methods, is being designed under the supervision of Westinghouse technicians.

For new methods and procedures to improve Signal Corps equipment and instructional literature and for improvements in the technical training program which resulted in the better utilization of radar equicment, **Professor William L. Everitt** E.E. '20, '22 of the University of Illinois received the exceptional civilian service award. The award was presented at a dinner on the Illinois campus at Urbana by Brig. General C. H. Arnold of the Office of the Chief Signal Officer. Professor Everitt who is head of Electrical Engineering department, was director of the operational research staff of the Chief Signal officer U. S. Army from March 5, 1942 until the end of the war.

Leonard Miscall C.E. '19 has gone to China as a special envoy for the Office of the Director General UNRRA. He is serving as a consultant on movements of supplies, construction materials and organization of constructional efforts. Mr. Miscall was a Navy Commander in the Seabees in the war and during his service did outstanding work in salvaging some units of the fleet sunk at Pearl Harbor and supervising the building of a mountain road in Trinidad. He sailed from San Francisco September 11 and will be in China until next summer.

Bryce I. MacDonald, Jr., B.Ch.E. '45, is now working for General Electric in Schenectady. His temporary home address is: 342 Eleanor Street, Schenectady, New York.

Out of Phase

By HERBERT F. SPIRER, EP '51

With this issue we introduce to our readers a new feature page—a page of humor, and one which we hope will be as well received as Jim Edison's "Caustic."

There is plenty of humor around the College of Engineering. Merely by looking out of the barred window in the ivory tower at 400 Lincoln, I find myself convulsed with belly-laughter. Just look at those jolly CE's merrily shoveling snow away from a bench mark. Do you see how white their ears are? That, Gregory, is the first sign of acute frostbite. What's that Gregory? You mean the emaciated little fellow hanging by his thumbs from the tree . . . No. Gregory, he is not the Slobbovian ambassador. . . . He was a promising EE until his flask of hydrogen exploded in the Chem Lab. Back to work, Gregory, we have a deadline to meet. The ENGINEER always comes out on time, now, y'know. Gregory is the little man who shucks all the corn before it appears in this column.

Guarantee: *We hereby guarantee our jokes to be older and cornier than any joke of similar size and price available at any other source. Reliable surveys show conclusively that NINE out of ten reform school graduates find this statement true. Make the T.I.M.* test yourself, today, and if you disagree, your boxtop will be returned to you immediately by the Lehigh Valley fast freight.*

The Rod and Snowshoe

No course receives as much attention per square freshman head as Surveying. During this class no heads nod, and no snores are heard. Any engineer who goes to sleep during a 210 field problem will more than likely not be found until the spring thaw.

Frostbite in Ten Easy Lessons, as taught by Professor Underwood who has survived more Arctic blizzards than Admiral Byrd, is not without its advantages. One group of would-be armature winders has found a way to make great sport of the transit. Setting the instrument near a walk, they aim the telescope directly across the walk. They gaze intently through the tube, and wait for a frosh coed to come up the walk. Just as the unsuspecting target is about to step into the line of sight, the playboys tear their hair furiously, shouting, "No, no, you'll be in the picture. . . . Don't get in front of the camera!"

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* *T.I.M.—Taste In the Mouth: Read one of our jokes. Does it leave that fuzzy taste in your mouth?*

This Wonderful World

News Release:

The Association of American Soap and Glycerine Producers reports that after three years of research in the Indian Jungle, soap has been proven to be the only sure antidote for cobra venom.

Lord Harvey Absinthe, D.S.S., his yellowed skin drawn tight over fevered bones, hacked at the undergrowth with his machete. Two thousand miles through the Indian jungle to the Afghanastanian border left their scars on his haggard frame. Two hundred native bearers had joined the safari only to drop dead on the trail.

Absinthe had a job to do and he was determined to make good. Only a few more rare Indian snails were lacking from his collection. Lord Harvey forced a grim, malarial smile as he thought of his book, *The Complete Sex Life of the Snail,* becoming a best seller.

"Aglrpfq!" cried a native bearer, rudely interrupting The Man's contemplation. Recognizing the danger cry of the local natives, Harvey jumped back. He was too late. Two monstrous fangs flashed out, and sunk deep into his shoulder. As the huge cobra slithered back into the dense maze of the jungle, Lord Harvey fell, to the ground, writhing in agony.

"Quick, Henry," he screamed to his deaf mute lackey, "Quick, Henry, the Lux!"

Henry, who had not yet seen the latest report of the Association of American Soap and Glycerine Producers, began to pour the contents of a gallon jug of Southern Comfort into the stricken man's mouth. Lord Harvey, reclining in his servant's arms, the pain only slightly dulled by the useless medicinal whiskey, felt his life ebbing away. He could have been saved! Soap floated by in front of his bleary eyes. Little bars, big bars, round bars, square cakes, chips, powders . . . Ivory, Rinso, Fels-Naptha . . . Oxydol . . . Sweetheart . . . Camay . . .

Lord Harvey opened his mouth as his eyes twitched nervously. As one man, the safari leaned forward, notebooks opened, pencils poised, tensely awaiting the great man's last words . . .

"Hic . . . !", he said, going limp. Today his bones are preserved in the basement of Goldwin Smith, a constant warning to all who would shun soap. *Requiescat in palmolive.*

Misbrint

Headline in the Cornell Daily Sun:

LONG TO REVEAL ISOTOBE SECRETS IN SCIENCE TALK

. . . Perhabs the lecture will be accombanied by exberiments.

Kodiak, the Eskimo, was sitting on a cake of ice telling a story. He finished it, got up, and said, "My tale is told."

See you all next month, same column, same corn.

Jack Drew

(*Continued from page* 18)

operator in the National Oil Products Company of Harrison, N. J., and as a chemical engineer with Goodyear Tire and Rubber Company in Akron, Ohio.

This year, coming down the home stretch, he has the additional headache of the job of steward for TKE. In spite of the ragging stewards always get, and the new shortages and unpredictable prices, he's doing fine.

"I have a couple of research deals on the fire now: 'A Study of Particle Size in Jaw Crushing'—feldspar, coal, shale, rock, quartz, and stuff like that—and a plant design: 'Hydroflouric Acid, the universal solvent'. Ugh! What are we going to keep it in?"

"After graduation? Well, I think I'd like to work back in dear old Boston. No, I don't have a worry in the world about competition from those MIT men. Guess that's about it! Thanks."

Guess so. Thanks and good luck, Jack.

Gene Carlson

(*Continued from page* 19)

stitution, the Cornell party." He feels that "a stein of beer and the fellowship of a song are the inevitable ingredients of friendship and good times, two factors which are indispensible components of college life."

As a civilian during the war, Gene was able, during off semesters, to gain experience in a wide range of industrial activities. One term, he worked as a metallurgical assistant for the Jones and Laughlin Steel Company; another term, he "sailed" the Great Lakes as a seaman for the Pickands Mather Iron Company; and this past summer was happily spent as a blueprinter with the C & O Railroad. Gene has found all of this work of considerable value and interest, particularly the metallurgical position, which, he says, "set me up for 3T31—a significant fact."

Gene will graduate at long last this coming June. They say that the successful man plans not for tomorrow, but for the day after tomorrow. Taking this sage advice to heart, Gene hopes to enter the field of sales engineering, preferably in some major industrial field. However, before he takes the big step, Gene plans to take "a nice paid vacation" at the shore of some similar place of a suitable nature for about three months next summer. But he adds, "In all seriousness, this is pure conjecture, for who can accurately say what he will be doing, even tomorrow?"

Natural Gas

(*Continued from page* 20)

This gasoline should have important uses in the future for it has high anti-knock qualities and gives 50% more mileage per gallon than gasolines now in use. It is especially well adapted to the high compression engines of the future.

In a few years one should see one-fourth of our soap made from natural gas. The extent of our natural gas deposits can be gained by realizing that only 1% of the natural gas reserve would be used up if all the soap in this country were made from it in the next 50 years.

Television

(*Continued from page* 14)

unobtainable. As one example, the early owners of home receivers found it impossible to detect the spectators sitting in the dim shadows of Madison Square Garden during the telecasts. The image orthicon has given such high definition to television that now no one in the stands escapes the all-pervasive camera eye. Henceforth the spectators will have to be considerably more wary of their antics at the boxing matches. This new-found clarity brings additional advantages to the televising of football games. No longer will fullbacks advancing down the field become mysteriously swallowed up by the long shadows cast by the stadium. The audience sees everything, regardless of lighting conditions.

Row A Center

The tube's inherent stability protects the screen image against sudden changes in light intensity. For instance, if a press photographer fires a flashbulb within close range of the television camera, the screen image is virtually unaffected. In combination with a telephoto lens, the image orthicon gives notable clarity to long-range reception. With just such a hookup, the telecast of the Lewis-Conn fight several months ago made the home audience feel as if it were sitting in Row A center. Actually, the recording cameras, mounted on a temporary platform, were some 135 feet removed from the ring. The image orthicon also exhibits greatly increased depth of focus over past models. Before the development of the image orthicon, the entire prizefighting ring at the Garden never came into sharp focus. Now not only is the entire ring seen clearly but several rows of seats beyond.

Light and Compact

Because the tube is light and compact, it is ideally suited for use in portable television cameras. The image orthicon photocathode area is one-fourth that of the orthicon and one-sixteenth that of the larger iconoscopes. The relatively large mosaic areas of the iconoscope and the orthicon require optical systems of considerable size. However, with the image orthicon, the optical system need be no larger than that employed with a standard 35-millimeter motion picture camera. The sizes and weights of the lenses included in the normal complement for the image orthicon are approximately one-quarter those needed for the iconoscope.

'Walkie-Lookie'

As the result of the high output signal provided by the image orthicon, the number of amplifier tubes required in subsequent stages is greatly reduced. Hence circuits formerly built into auxiliary equipment may now be conveniently incorporated within the camera itself, thus leading to further compactness. Today the average camera, containing seventeen vacuum tubes, weighs only forty pounds. Since the invention of the image orthicon, scientists have been renewing their efforts to devise a "walkie-lookie," a light-weight, portable television camera with all the ease of operation attributed to present-day "walkie-talkies."

(*Continued on page* 30)

Television

(*Continued from page* 28)

Now that light intensity is no longer critical, brilliant studio illumination is neither necessary nor desirable. Henceforth actors and technicians will not be required to wilt under batteries of dazzling floodlights. Furthermore, the image orthicon makes it possible to cut lighting costs in studio operation and thus markedly reduce program budgets. This resultant economy has made more than one television sponsor emit a lusty hallelujah.

Television Everywhere

At last the entire world of events falls within the province of the television cameraman, whether he is recording a prize fight, a presidential inauguration, a vox-pop street interview, a six-day bike race, a courtroom trial, operas, plays, concerts, parades, atomic explosions, or just some Park Avenue lollipop carousing in one of the darker corners of a midtown night club. But probably the most significant, although not the most constructive, uses made of the image orthicon to date have been undertaken by the Army and Navy. In fact, so great was the importance of this development to our armed forces that, ranking with radar and the proximity fuse, the image orthicon was one of this country's most closely guarded wartime secrets. Even now, many details of its military application are still being kept under wraps.

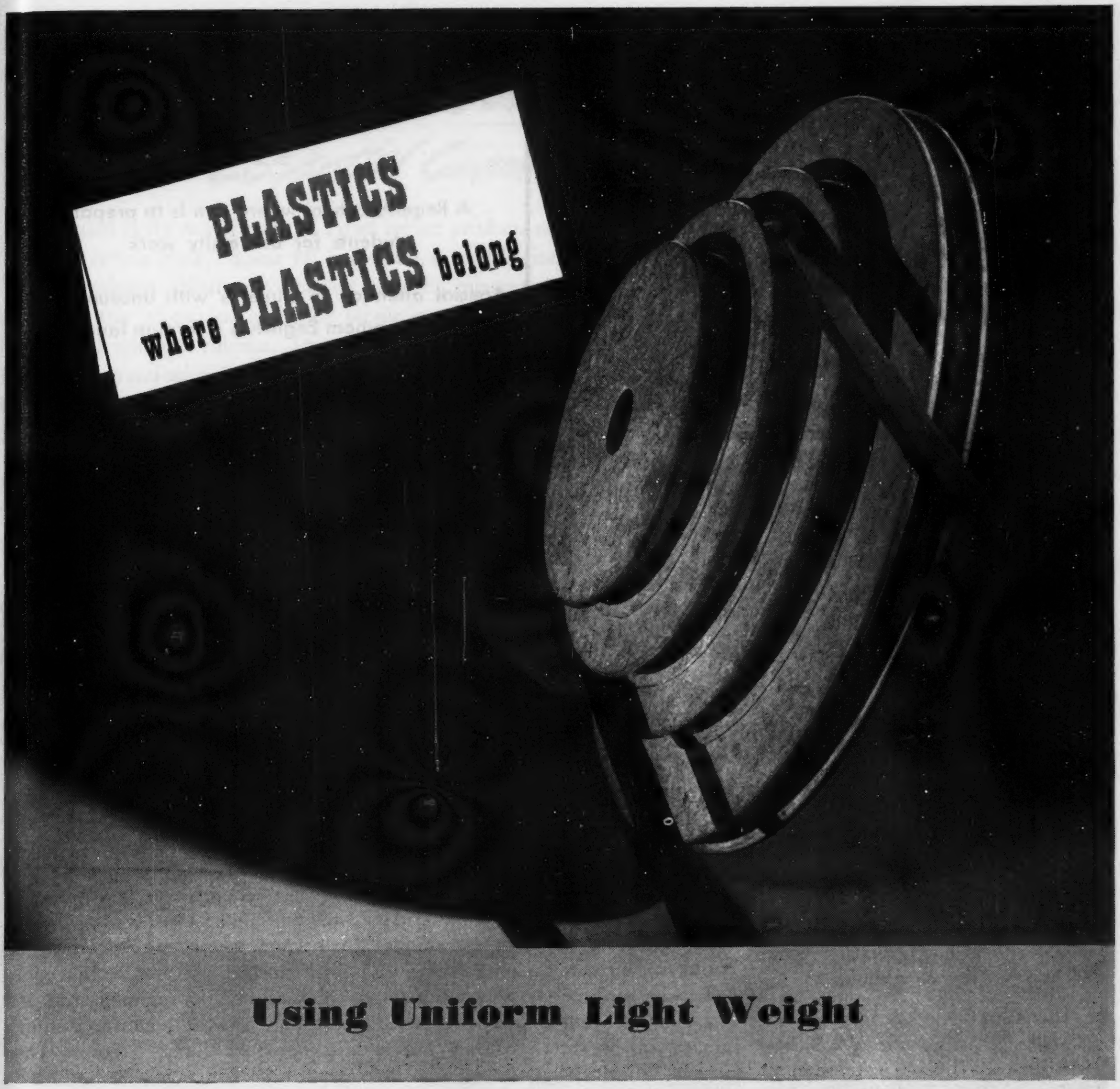
In The Air

The Navy, however, reported that as early as 1940 television served as the eyes of a pilotless torpedo plane, radio controlled and television directed. A television camera placed in the nose of the ghost plane was allowed to scan the terrain below and transmit its images to the screen in a guiding plane some one hundred miles away. Many such assault planes were placed under test and ultimately pressed into service during the war. Fast-flying Marauders carried image orthicon equipment capable of transmitting high quality pictures as far as two hundred miles from an altitude of 22,500 feet. Television was used to direct crash-boats against enemy objectives. Even television-controlled gliders carrying explosives were used to destroy enemy land and sea targets. With the aid of the image orthicon, it was possible to employ robot aircraft for general reconnaissance and for the direct observation of gunfire.

Attention: Test Engineers

Many free-falling, radio-controlled bombs and flying torpedoes were television equipped. The image orthicon also served to transmit maps and charts between ships and aircraft. Particularly noteworthy in the testing of new types of aircraft was the ability of television cameras to transmit meter and gauge readings on aircraft instrument panels. For test engineers, television utterly obliterated the consequences of space and speed. Under the severe conditions that might cause a test pilot to blank out completely, airborne television operated with unimpaired effectiveness. Especially toward the end of the war, the image orthicon gave to airborne television extraordinarily improved see-

(*Continued on page* 32)


PLASTICS
where PLASTICS belong
Using Uniform Light Weight

Television

(*Continued from page* 30)

ability. Pilots of the future will seriously wonder how aviation ever managed to survive without it.

On The Alert

The image orthicon may well become the ever-vigilant watchman of the future. It can readily be employed to keep a continual lookout at railroad crossings and traffic intersections, giving its accurate report to a screen some distance removed. The remarkable skill of the image orthicon to see and yet not be seen suggests revolutionary methods of crime control. This possibility has not escaped the attention of the Federal Bureau of Investigation.

Push-Button Engineers

The image orthicon requires no special lighting and other cumbersome accessories and may be conveniently used in the presence of radio-active materials, extreme heat, and other hazards which might make direct, instant-by-instant observation next to impossible. As a means of industrial control, an engineer may wish to install a television camera at some point critically affecting the outcome of his process. Without budging from his office, he need merely press a button to view its well-defined television image on a screen within arm's reach. What a boon to engineers of the push-button persuasion!

Going Places

The image orthicon can be used to advantage for advertising within retail stores. Not long ago, Gimbels in Philadelphia set up twenty "telesites," where customers were able to watch fashion shows and merchandise displays on large, 6 by 21 ½-inch television screens. The image orthicon has also been employed successfully in connection with color television cameras, where it exhibits the same superiority characteristic of its operation in black-and-white television.

The Four Million

Recent surveys indicate that in America today there are four million families ready and waiting to buy television receivers. These four million families want a record of the contemporary world presented without the interpretive bias typical of radio news commentators and without the deadly editing common to newsreel cutting rooms. They want news coverage that is accurate and complete. They want spot news, anywhere and at any time. They want to see and to hear the news as it happens. But mainly they want to see it. The image orthicon has met that need. In fact, unlike anything known before, it has ushered in an altogether revolutionary brand of television, the full social implications of which completely escape our present comprehension. Of one thing, however, we are certain. The image orthicon, by giving new vision to television, has done more to improve the art than any other single invention. Now at last we have the power to transform into a vital and living adventure the record of our times, buried for so long in the drab lifelessness of our daily newsprint.

Autopilot

(*Continued from page* 10)

the control surfaces of the airplane by means of cables clamped to the regular control cables. There is one servo unit for each control surface and it is located as close as possible to it. Thus the cables connecting the servos and the surfaces are short and much less likely to be damaged by gunfire in addition to being less affected by temparature changes.

The directional stabilizer, located in the nose of the ship, contains a horizontal gyro which detects any deviation of the plane from straight flight. When such a deviation occurs electric signals are sent to the servo units directing them to correct the deviation. The directional stabilizer is also a part of the bombsight assembly, and by causing signals to be sent from an attachment on the stabalizer to the servos the bombardier may take control of the ship and steer it while synchronizing on the target.

The vertical flight gyro detects any deviation of the ship from level flight, and is mounted near the center of gravity of the airplane. It, like the horizontal stabalizer, measures electrically any deviation it detects, and produces signals which are sent to the servos causing them to apply the proper control to correct the variation.

The amplifier receives the electric signals sent by the other units. It amplifies these signals which in turn direct the proper servos to apply a definite amount of control in the necessary direction.

The rotary inverter is a generator which operates on the airplane's direct current power supply and provides the alternating current necessary for the operation of the autopilot.

The junction box is a central wiring station for the various units of the C-1. It saves wire and makes maintenance and checking of the circuits much simpler.

Control Panel

The autopilot control panel (A.C.P.) is located in the pilot's compartment and contains the lights, switches, and knobs for engaging the autopilot and adjusting its operation to compensate for changes in flight conditions. On the A.C.P. are the tell-tale lights which show when the electrical trim of the ship, by the autopilot, agrees with the mechanical trim set up by the pilot before engaging the autopilot. If the lights are out, the trims coincide. If they flash, the centering knobs may be used to adjust the electrical trim until the lights are out. The sensitivity knobs regulate the distance the airplane is allowed to deviate from straight and level flight before signals are sent to the servos to correct the variation. The ratio knobs regulate the amount the servos move the control surfaces for any given deviation of the ship. The turn control enables the pilot to make a coordinated turn, (one in which he loses no altitude) with the autopilot. The turn compensation knobs regulate the amount of control necessary for the bombardier to apply when he is steering the ship and wishes to make a coordinated turn. The remote control transfer knob shifts the turn control operation to a remote turn control station in either the bom-

(*Continued on page* 36)

John R. Mott

(Continued from page 15)

Dr. Mott became interested in Y.M.C.A. work while a student at Cornell, and he became president of the Cornell Chapter of the Y.M.C.A. Upon graduating from Cornell with his Ph.D., Dr. Mott became Student Secretary of that organization in New York, and his rise to the Presidency of the World Alliance of Y.M.C.A. is one of the most spectacular on record. He founded the World Student Christian Federation and is today the permanent Chairman of the International Missionary Council.

Dr. Mott must have used the same principle that is used by the top British bridge-playing expert, Simon: "Go after the best result possible, not the best possible result." That he has succeeded may be shown by the fact that he has raised over $300,000,000 for his causes, and that he has been appointed many times by the United States Government to represent our country on foreign commissions. Dr. Mott has received awards from nearly every nation of the world, including the Distinguished Service Medal from the United States for his work during World War I.

That he had a very liberal and compromising stand in his views is shown in his works toward prohibition. He advocated the eighteenth amendment and upheld it entirely until 1932, when he changed his policy and stated that since another generation would have to live under prohibition, it was up to that generation to decide whether or not it wanted prohibition, and that a new vote should be taken. Similarly in the international narcotic menace, he was pleased with the efforts being taken, and in 1935 said that the stoppage of the drug trade was highly successful in spite of China. Many in his field were disgusted with the efforts taken in China and recommended rash plans, but Mott praised Chiang Kai-Shek and said that he was doing a very practical and lasting job in eliminating narcotics. Dr. Mott has always realized that the best methods are the most lasting methods. He has been called one of the ten greatest Cornellians.

Autopilot

(Continued from page 34)

bardier's or the navigator's compartment.

An analogy may be drawn between the human pilot and the autopilot by considering the gyros to be the eyes of the C-1, detecting any variation from normal flight. The amplifier serves as the autopilot's brain sending signals out on the electric circuits or nerves to the servo units which correspond to a human pilot's muscles.

Standard Equipment

The C-1 was standard equipment on all Army Air Force bombers. Without the increased bombing accuracy it brought about, more planes would have been required to knock out a given target and as a result the war might have lasted much longer. The future of the C-1 autopilot is as uncertain as that of any other World War II weapon. One thing is certain, however, and that is that the C-1 was one of the largest single factors in the remarkable success of our strategic bombings of Axis-dominated objectives.

Metallurgy

(Continued from page 9)

very important problems in the use of welding processes. Such studies require a careful evaluation of the behavior of metal on melting, solidifying, and cooling, and involve the effects of oxidation, gas absorption, inclusions, diffusion, grain growth, contraction and expansion, structural changes, changes in physical properties, and the cause and relief of residual stresses. The most valuable improvements in the science of welding have been made in recent years by the application of fundamental chemical and physical principles through research.

The Welding Laboratory, adjacent to the Foundry Laboratory, is also a part of the new Division of Metallurgical Engineering. New equipment will be needed to complete this laboratory in order that it can serve to provide elementary and advanced training, and facilities for conducting student and staff research projects of a fundamental nature.

The Light Metal Industry

One very fascinating challenge to the metallurgical engineer will be the development of new and stronger aluminum, magnesium, and possibly beryllium alloys, and the improvement in the methods of fabrication of those already in use. A fundamental study of the cold-forming operations on aluminum alloys resulted in further advantages to their use in the aircraft industry during the war. Aluminum and magnesium casting alloys have in the past presented problems in the foundry. Further study of the fundamental problems will advance the entire industry immeasurably.

To take full advantage of the light alloys, the aircraft industry needs larger forgings than have been made formerly. This has resulted in a more careful study of the flow of metal in dies, the rate of flow in forging operations, and many other problems which in the past have been solved by rule-of-thumb methods. The metallurgical engineer will play a very important part in this development in the future.

The welding of aluminum and magnesium alloys has brought

(Continued on page 40)

Du Pont *Digest*

Items of Interest to Students of Chemistry, Engineering, Physics, and Biology

The "Whitest of White" Pigments from Black Ore

It is a strange fact that the ninth most prevalent element in the earth's crust should have been regarded as "rare" for over a hundred years after its discovery in 1791. But that is the story of titanium, actually more abundant than zinc, copper, lead, tin, and nickel combined. One of the factors that have kept titanium from being better known is the difficulty of handling some of its compounds commercially.

If, as a student, you were to look up the equations for the manufacture of titanium oxide pigment, you might find something like this:

$$FeTiO_3 . nFe_2O_3{}^* + (3n+3)H_2SO_4 \longrightarrow Ti(SO_4)_2 + FeSO_4 + nFe_2(SO_4)_3 + (3n+3)H_2O$$

$$Fe_2(SO_4)_3 + 2H^+ \longrightarrow 2FeSO_4 + H_2SO_4$$

$$Ti(SO_4)_2 + (x+2)H_2O \longrightarrow TiO_2 . xH_2O + 2H_2SO_4$$

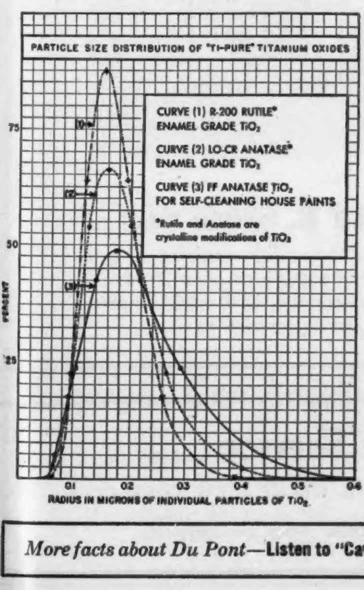
$$TiO_2 . xH_2O \longrightarrow TiO_2 + xH_2O$$

*—The exact composition of ilmenite varies with the source of the ore.

From these equations, the manufacture of the "whitest of white" pigments from black ilmenite ore appears to be chemically simple and straightforward. However, the processing required to obtain industrial titanium oxide of sufficient brightness, hiding power and fineness is more complicated than one would anticipate.

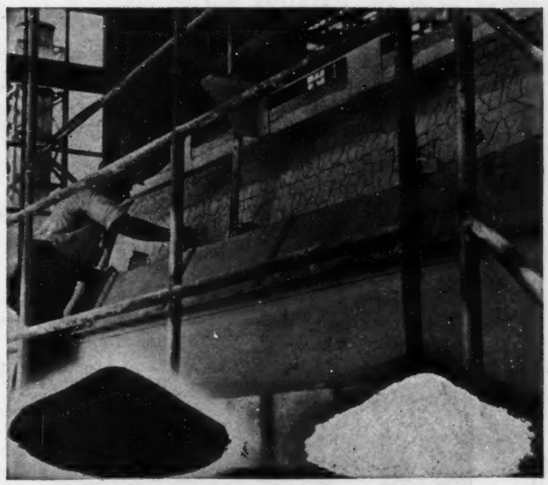
Controlling a Metastable System

The final product must have a particle size averaging 0.2 microns in radius and varying between 0.1 and 0.5 microns.



To attain this end in a metastable system that is ready to go in the wrong direction at any time requires exceedingly rigid control conditions throughout.

The essential steps in the operation are: 1) The careful solubilization of ilmenite in concentrated sulfuric acid to avoid hydrolysis. 2) The complete reduction of any ferric iron to facilitate purification of the solution, with removal of any unconverted residue and colloidal slimes. 3) Crystallization of 70 per cent of the iron as $FeSO_4.7H_2O$—a critical operation in which temperature must be kept low and wild seed crystals avoided. 4) Hydrolysis around 105-109° C.—the most important step of all—because the initial particle size and pigment properties of the final product depend on concentration, temperature, time of hydrolysis, intensity of stirring, and presence of foreign materials. In this operation it is not unusual to talk in terms of parts per million, rather than the usual analytical accuracy of 0.01-0.02 per cent. 5) Varying salt treatment of the precipitate, depending on the impurities. 6) Calcination between 900-1000° C. to obtain the desired particle size. 7) Grinding to give the proper aggregate size. 8) Treatment of the dried pigment in various ways depending on end use; e.g., in the automotive, rubber, ceramics, paper, linoleum, printing, or other fields.



Ilmenite (left). Titanium Dioxide (right). Apparatus in the background is a rotary filter.

Wide Diversity of Research Problems

Long and patient research was necessary to develop the manufacturing techniques now used. Some of the problems demanded technical skill of the highest order from the colloid chemist, the physical chemist, the analyst, the crystallographer, the physicist, and other specially trained men. A wide variety of instruments, such as the petrographic microscope, the electron microscope, x-ray diffraction unit, ultra-centrifuge, and spectrophotometer were used in this work. Finally the metallurgist, the chemical engineer, the mechanical engineer, and the industrial engineer had to design equipment to handle this extremely corrosive system economically.

The manufacture of titanium pigments is another example of the problems that constantly challenge chemists, engineers and other specialists.

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Metallurgy

(*Continued from page* 38)

about the development of gas-shielded welding processes. Further development along these lines will require the guidance of metallurgical engineers with a knowledge of the chemistry of gases and gas absorption phenomena in liquid metals.

Other Industries

Space does not permit a coverage of all of the industries where the graduates in Metallurgical Engineering will find employment. The steel industry, including the steel casting industry, has many particularly challenging problems. Precision casting of alloys which are difficult to forge and machine has provided industry with many metal products and future developments will extend the scope of this process. In the applications where high temperature service is necessary and where corrosion conditions are particularly severe, the metallurgist is experiencing very keen competition from non-metallic materials and must meet this competition with new alloys developed through extensive basic research in the fundamental behavior of metals under such conditions. The electrical industry is also making unusual demands on the metallurgist by requiring metals with very unique electrical properties.

Plans are now being made to develop the staff and laboratories necessary to launch the new curriculum in Metallurgical Engineering. The Foundry, Metal Working, and Welding Laboratories are now being used for instruction in service courses for students in Mechanical and Electrical Engineering and in Engineering Physics. These will be expanded and new equipment will soon be available to provide instruction in the most modern phases of this work, and to accommodate student and staff research activities.

The Metallography Laboratory in Olin Hall is well equipped to carry out a very effective program of teaching and research in this field and in the fundamental field of physical metallurgy. Additional laboratory facilities will be provided in Oin Hall as a temporary location until the new Materials and Metallurgy Laboratories are completed. These new laboratories are to be located on the site of the old Armory and the adjoining land to the east along Cascadilla Gorge. They will consist of five major units and will constitute the largest building of the new engineering college campus.

E. H. Dix

(*Continued from page* 17)

Course in Materials Testing, under the able guidance of Professor Upton, led E. H. Dix to become intensely interested in materials testing. Taking advantage of the Morse Hall fire, he rigged up an old Leitz microscope and one of the undamaged polishing machines from Sibley so that he could receive special instruction in materials testing from Professor Chamot. Excellence in his work in metallurgy and materials testing led to his election to Sigma Xi, and by the time Mr. Dix left Cornell in 1916, having received his MME degree, he was well on his way in the direction of metallurgy.

During World War I, Mr. Dix tested aircraft materials and expedited work for the aircraft production stationed at the Bureau of Standards. When the work which had been done at the Bureau of Standards was transferred to the General Laboratories of the Bureau of Aircraft Production at Pittsburgh, the organizing of the testing department was due to the work of E. H. Dix, who later became its chief. After supervising the material testing work and conducting investigations of aluminum alloy compositions at the newly created Lynite Laboratories of the Aluminum Castings Co. for a year at the close of the war, he resigned to become Chief of the Metals Branch, Material Section of the Engineering Division, Air Service, U. S. Army, Dayton, Ohio. It was in the experimental foundry at Dayton that the first aluminum cylinder head castings for air-cooled aircraft engines were produced in this country, and it was here that Mr. Dix conducted several investigations of new and important aluminum alloys, among them the aluminum-silicon-copper series.

He joined the Aluminum Company of America in 1923 as the head of the New Kensington Metallurgical Division of the Research Bureau, and in 1930 was appointed to one of his present positions, Chief Metallurgist in charge of two sections of the Metallurgical Division of the Aluminum Research Laboratories at Cleveland and New Kensington.

Dix's activities in technical and scientific societies have been many, including the chairmanship of the Institute of Metals Division and of the Pittsburgh Section of the American Institute of Mining and Metallurgical Engineers from 1935-1937. He is also a past chairman of the Pittsburgh Chapter of the American Society for Metals, is a member of the British Institute of Metals, the Society of Automotive Engineers, and of several committees and sub-committees of the American Society for Testing Materials.

During World War II, Dix was a member of the Subcommittee on Aircraft Metals and of the Committee on Aircraft Construction of the National Advisory Committee for Aeronautics. In 1942 he was made Assistant Director of Research with the Aluminum Company of America. Mr. Dix was not only the inventor of the alclad strong alloy sheet used in transport and military airplanes, but it was under his direction that many new and highly useful alloy compositions and products have been developed.

NOTICE TO ALUMNI

The College of Engineering is interested in acquiring equipment for laboratory and classroom use. Frequently either no information or insufficient information has been available in regard to the character of the equipment and the location where it may be inspected.

It would be appreciated if alumni knowing of machine tools, electrical apparatus, metallurgical equipment, etc., available for distribution or sale as surplus property, would write or wire Dean S. C. Hollister, College of Engineering, Cornell University.

CIVIL ENGINEERING

by **Director Malcolm**

Watch for the March issue of the

Cornell Engineer!

STRESS *and STRAIN...*

"Darling Daisy," wrote Clem to his beloved. "I would swim the mighty ocean for one glance from your dear eyes. I would walk through a wall of flame for one touch of your little hands. I would leap the widest stream for one word from your lovely lips. As always, your Clem."

..P.S.—I'll be over Saturday night if it doesn't rain."

Speaker: *"Now folks, I want to tax your memory."*

Voice in audience: *"Good grief! Has it come to that!"*

A little boy and his mother were walking down Fifth Avenue in New York City. The little boy was looking at the skyscrapers. Turning to his mother he said, "Are there skyscrapers in heaven?"

His mother replied: "No dear, engineers build skyscrapers."

Teacher: "Willie, define the word puncture."

Willie: "A puncture is a little hole in a tire, found a great distance from a garage."

Captain to man leaning over rail of ship: "I see you have a weak stomach."

Sea-sick man: "I don't know about that. I'm throwing it as far as anyone else."

"Are you sure he was intoxicated?"

"No, sir, not positive; but his wife said he brought home a manhole cover and tried to play it on the victrola."

A censor is a lovely man—
I know you think so too;
He sees three meanings in a joke—
When there are only two!

Balch: "Will you have a peanut?"

Risley: "No, they're fattening."

Balch: "What makes you think peanuts are fattening?"

Risley: "Have you ever seen an elephant?"

"Henderson is our best salesman—that guy could sell anything."

"That so?"

"Well, yesterday a widow came in to buy a suit in which to bury her husband, and he sold her one with two pairs of pants."

The stout lady on the scale was eagerly watched by two small boys. The lady dropped in her cent, but the machine was out of order —it registered only 75 pounds.

"Good night, Bill," gasped one of the kids, in amazement, "She's hollow!"

Woman on telephone: *"I sent my little boy to your store for two pounds of plums, and I got only a pound and a half. Your scales must be wrong."*

Fruit dealer: *"My scales are all right, madam. Have you weighed your little boy?"*

At a dance a wallet was lost containing $600. The owner got up on a chair and announced: "Gentlemen, I lost my pocketbook with $600 in it. To the man who finds it I will give $50."

Voice from the rear: "That's nothing, I'll give $75."

"The boss said if I worked like a beaver he'd give me a raise."

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